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Respiratory Support for Patients with Severe COVID-19 Disease: A Major Challenge for Low-Resource Settings

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Abstract

Background: Respiratory support of severe COVID-19 patients is crucial for their survival. The aim of this study was to describe types of respiratory support options and their therapeutic outcomes at a referral ICU in Cameroon.

Methods: This was a prospective study carried out at the ICU of the Yaoundé Central Hospital between March 1, 2020 to May 31, 2021. We enrolled patients with laboratory-confirmed and/or CT-scan-confirmed SARS-CoV-2 infection presenting with severe respiratory distress, hemodynamic instability and/or altered consciousness. The means of respiratory support used, the therapeutic outcomes and the risk factors for mortality were studied.

Results: Overall, 217 severe COVID-19 patients were enrolled; mean age 51.03 ± 16.80 years and sex ratio 1.61. Their main comorbidities were hypertension (28.57%) and diabetes mellitus (21.65%). Acute respiratory distress was observed in 62.19% patients and 40.54% had lung parenchymal involvement greater than 10%. The mainstay of respiratory support was NIV (62.22%) via simple facemask (50.23%), high concentration oxygen mask (44.70%), and CPAP (38.25%). IMV was performed in 6.91% of cases. The overall mortality rate was 11.52% with a 100% case fatality rate IMV cases. Risk factors for mortality were age ≥ 70 years, hypertension (OR: 3.222; 95% CI 1.360-7.635; p=0.0047), heart failure (OR: 4.381; 95% CI: 1.741-11.020; p=0.0015) and critical lung disease (OR: 3.160; 95% CI: 1.314-14.645; p=0.000), IMV (OR: 6.380; 95% CI: 3.624-43.145; p=0.000).

Conclusion: Respiratory support of severe COVID-19 patients is quite challenging in resource-limited settings especially with regard to IMV. Non-invasive oxygen therapy would be an option to reduce mortality from severe COVID-19.

Keywords: non-invasive ventilation, invasive mechanical ventilation, severe COVID-19, respiratory support

Abbreviations: IMV: Invasive mechanical ventilation; NIV: non-invasive ventilation

Introduction

A new flu-like viral disease called Coronavirus disease 2019 (COVID-19), disease, caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) out broke in December 2019 in China. Then, it rapidly spread worldwide, causing billions of infects and millions of deaths enough to be declared as an unprecedented pandemic by WHO in March 2020 [1-4]. COVID-19 is a multi-systemic disease with various forms of clinical presentations, stratified into mild, moderate and severe. Mortality related to COVID-19 disease is often due to respiratory complications of its severe forms such as acute respiratory distress syndrome (ARDS)and pulmonary embolism which warrant intensive care unit (ICU) admission for respiratory support by either non-invasive or invasive ventilation.

In Cameroon, the ICU of the Yaoundé Central Hospital (YCH), a major referral tertiary center in Cameroon, was the first to administer respiratory support to severe COVID-19 patients. The objective of this study was, therefore, to describe our experience in respiratory management of severe COVID-19 patients by describing the various means of respiratory support used and treatment outcome at the ICU of YCH.

Materials and Methods

Study design, setting and population

This is a prospective cohort study conducted at the ICU of YCH from March 1, 2020 to May 31, 2021. After approval by the National Ethics Committee and obtaining written informed consent from patients or their legal guardians, patients admitted to the ICU with severe COVID-19 defined as having a positive SARS-CoV2 serological test (rapid diagnostic test-RDT) or positive SARS-CoV-2 reverse transcription-polymerase chain reaction (RT-PCR) and/or characteristic ground-glass appearance of thoracic CT-scan.

Patient management and respiratory support

On ICU admission, respiratory status was assessed by respiratory rate (RR) and pulse oxygen saturation at room air (SpO_2 AA). Respiratory resuscitation was based on the patient's respiratory status. If the RR < 20 cycles/minute and the SpO_2(AA) > 94%, the patient was not oxygenated. When the RR > 20 cycles/minute and/or the SpO_2 (AA) between 90 and 94%, the patient was oxygenated with a simple face mask at a flow rate of 8 to 10 l/min. When the RR > 20 cycles/minute and the SpO_2 (AA) < 90%, oxygenation was started with a high oxygen concentration mask at a flow 15 to 20 l/min, then the installation of a continuous positive airway pressure (CPAP) at a flow rate of 15 – 40 l/min, in case of failure. Lastly, if there was no improvement, endotracheal intubation was performed and mechanical ventilation started. In all cases, when a means of respiratory support failed, the patient was quickly switched to another option with a higher inspired fraction of oxygen (FiO_2).

Generally, the medical treatment of patients was according to the Cameroonian national protocol for the management of COVID-19 cases validated by the scientific council for public health emergencies [5]. This protocol combined hydroxychloroquine, azithromycin, enoxaparin, methylprednisolone, vitamin C, zinc, ciprofloxacin or amoxicillin-clavulanic acid. Control of comorbidities required specific drugs. Depending on the condition of the patient, corrections could be added to the treatment.

Study variables and data analysis

The variables studied were sociodemographic data (age and gender), clinical details (past history, qSOFA score, RR, SpO_2) and laboratory/imaging results (RDT, RT-PCR, chest CT-scan), type of respiratory support (simple face mask, high concentration oxygen mask continuous positive airway pressure-CPAP ventilation, invasive mechanical ventilation) and treatment outcomes. Data analysis was performed using Epi info 3.5.4 statistical software. Means and standard deviations of numerical variables were reported. Categorical variables were analyzed using the Fisher's exact test or the Pearson's Chi-square test where appropriate. Qualitative variables were analyzed using the Student t-test or the Kruskal-Wallis test where appropriate. The threshold for statistical significance was set a p-value less than 0.05.

Results

General characteristics of the study population

During the study period, 217 severe COVID-19 patients were enrolled. Their average age was 51.03 ± 16.80 years and 61.8 % were males, hence, sex ratio of 1.61. COVID-19 was RT-PCR confirmed in 58.99%. On ICU admission, 69.12% had a clinical septic profile (qSOFA ≥ 2), and grave respiratory parameters; 69.12% had a RR > 20 cycles / minute, 33.64% had a SpO_2 (room air) < 90% and 40.54% had a significant lung parenchymal involvement on CT-scan. as illustrated in Table 1.

Table 1: Characteristics of the 217 patients on admission.

Characteristics	n = 217
Sociodemographic characteristics	
Mean age (years)	51.03 ± 16.80
Gender : Male / Female n (%)	134 (61.8 %) / 83 (38.2%)
Comorbidities	
Hypertension n (%)	62 (28.57%)
Diabetes mellitus n (%)	47 (21.65%)
Heart failure n (%)	36 (16.58%)
Chronic kidney disease n (%)	6 (2.76%)
Active cancer n (%)	7 (3.22%)
HIV n (%)	5 (2.30%)
Hepatitis C infection n (%)	4 (1.84%)

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Clinical characteristics	
qSOFA < 2 n (%)	67 (30.88%)
qSOFA ≥ 2 n (%)	150 (69.12%)
Respiratory rate on admission n (%)	
≤ 20 cycles / minute	67 (30.88%)
> 20 cycles / minute	150 (69.12%)
SpO2 (room air) on admission n (%)	
>94%	67 (30.88%)
90 – 94	77 (35.48%)
< 90%	73 (33.64%)
Laboratory tests n (%)	
RDT	89 (41.01%)
RT-PCR	128 (58.99%)
Lung involvement on CT-scan n (%)	
Minimal < 10%	16 (7.37%)
Moderate (10-25%)	36 (16.59%)
Range (25-50%)	18 (8.29%)
Severe (50-75%)	16 (7.37%)
Critical (>75%)	18 (8.29%)

RDT: Rapid diagnostic test; RT-PCR: reverse transcription-polymerase chain reaction

Respiratory support and outcome

According to the treatment protocol of our study setting, 150 patients (69.12%) had respiratory support with means of supplementary oxygen. The main modalities were simple face mask oxygenation (50.23%) and high concentration oxygen mask (44.70%). Only 6.91% had invasive mechanical ventilation (Table 2). The management of these severe COVID-19 patients resulted in an in-ICU mortality rate of 11.52% (25 deaths). All the deceased patients were on respiratory assistance, including 15 (6.91%) patients on invasive mechanical ventilation (Table 3). Severe COVID-19 mortality was clinically related to ARDS. The mean length of ICU stay was 10.28 ± 5.19 days. The average age at which patients died was 67.08 ± 11.89 years and the average length of hospitalization of the deceased was 4.36 ± 6.93 days. Risk factors for mortality were age ≥ 70 years, hypertension, heart failure, critical lung disease and invasive mechanical ventilation (Table 3).

Table 2: Modalities of respiratory support.

Respiratory support	n = 217
Non-oxygenated patients n (%)	67 (30.87%)
Simple face mask oxygenation n (%) O_2: 8-10 l/min	109 (50.23%)
High concentration oxygen mask n (%) O_2 : 15 – 20 l/min	97 (44.70%)
CPAP oxygenation n (%) O_2 : 15 – 40 l/min	83 (38.25%)
Invasive mechanical ventilation n (%)	15 (6.91%)

CPAP: Continuous positive airway pressure.

Table 3: Analysis of risk factors of mortality (N=217).

Risk factors	n (%)	Deaths (n)		p- value	OR (95% CI)
		No	Yes		
Age 70 – 79 years	15 (6.91%)	20	5	0.0156	4.166 (1.269 – 13.677)
Age 80 – 89 years	11 (5.07%)	19	6	0.0005	12.943 (3.166 – 47.292)
Hypertension	62 (28.57%)	12	13	0.0047	3.222 (1.360 – 7.635)

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Heart failure	36 (16.59%)	15	10	0.0015	4.381 (1.741 – 11.020)
Critical pulmonary involvement (>75%)	18 (8.29%)	16	9	0.000	3.160 (1.314 – 14.645)
Non-oxygenated patients	67 (30.87%)	67	0	0.379	0.768 (0.434 – 1.671)
Simple face mask oxygenation O_2: 8-10 l/min	109 (50.23%)	109	0	0.453	0.839 (0.427 – 3.057)
High concentration oxygen mask O_2 : 15 – 20 l/min	97 (44.70%)	96	1	0.201	0.425(0.094-1.910)
CPAP oxygenation O_2 :15 – 40 l/min	83 (38.25%)	74	9	0.0047	3.222 (1.360 – 7.635)
Invasive mechanical ventilation	15 (6.91%)	0	15	0.000	6.380(3.624 – 43.145)

CI: confidence interval; CPAP: Continuous positive airway pressure; OR: odds ratio; HTN: Hypertension

Discussion

The Yaoundé Central Hospital was the first hospital in which the first case of COVID-19 as well as the first severe forms were managed in Cameroon. The present study objective was to present our experience in the respiratory support set up for severe COVID-19 patients, and its results for a pathology which was unknown hitherto. It is worth mentioning that the period of the study corresponded to the first two waves of the pandemic.

The average age of patients in our series was 51.03 ± 16.80 years and the majority of patients were male adults (age ≥ 40 years). The predominance of adult men is due to the fact that, in Cameroon, men represent the main workforce of the country and bread earner for most families. To this effect, men are subject to great mobility which promotes contact and also the risk of contracting COVID-19. Similar findings were seen in China where most COVID-19 patients admitted to the ICU were male adults [6-8]. Studies by Collienne et al in Belgium, Donamou et al in Guinea, Gado et al in Niger, and Ngomas et al in Gabon reported equally concur on an adult male predominance [9-12]. The main comorbidities found were hypertension, diabetes mellitus and heart failure which are in line with the prevailing public health pathologies in Cameroon. Likewise, these three comorbidities had been highlighted as predominant in the series by Collienne et al, Donamou et al, Gado et al and Ngomas et al [9-12]. On ICU admission, 69.12% presented with acute respiratory distress based on thier RR and SpO2 room air. These were the main parameters we could readily measure to evaluate respiratory function because blood gas analysis was not available at the study setting. Donamou et al, and Ngomas et al also used RR and SpO2 to assess respiratory function in their study [10,12], unlike Benhocine in Algeria who measured blood gases [13]. In 30.88% of cases, the patients showed no respiratory distress (RR<20/min, SpO2>94% in room air). These were stable patients who were probably in the latent phase of the COVID-19 infection, thus, belonged to profile L according to Gattinoni et al [14]. Donamou et al, Ngomas et al had made similar observations, as profile L patients represented 23% and 28% of cases respectively [10,12].

Regarding respiratory management, it consisted of non-invasive oxygen therapy in the majority of cases (62.22%). Generally, at the onset of the pandemic, mechanical ventilation was widely used for respiratory support but in our context, it was not the priority due to the few available equipment and trained personnel. The ICU had two functional ventilators, four multi-parameter monitors, four electric pump syringes, and twenty ICU beds. As human resources, there were three anesthesiologists-intensivists, a paucity of generalist nurses with no training, knowledge and skill on the monitoring of mechanical ventilation. Hence, it was safer to resort to non-invasive oxygen therapy than invasive mechanical ventilation as seen in this study.

Invasive mechanical ventilation was carried out under difficult conditions marked by insufficient number of electric pump syringes, opioids, hypnotics and neuromuscular blockers and no analysis of blood gases. Regarding this aspect of respiratory management, our study differs from that of Benhocine et al in Algeria, and that of Grasseli et al in Italy, which had favored invasive mechanical ventilation in 81.51% and 88% of cases respectively [13,15]. However, the sub-Saharan African series for their part highlighted non-invasive ventilation, invasive mechanical ventilation representing only 4 to 16% of cases [10,12].

Despite the rigorous application of the national therapeutic protocol, notwithstanding the control of the septic state and the comorbidities of the patients, the mortality rate recorded in our context was 11.52%, including 100% for patients who were intubated and ventilated. The mortality rate in our setting was lower than those of Donamou et al (25%) [10], Grasseli et al (26%) [15], Ngomas et al (41.7%) [12], Bhatraju et al (50%) [16], Yang et al (61.5%) [8] and Benhocine et al 78.15%) [13]. The low death rate found in our series can be explained on the one hand by the fact that not all the severe COVID-19 patients who arrived in the ICU had been managed in other health facilities. Some had auto medication at home and others were managed by traditional healers. On the other hand, the systematic use of enoxaparin in all bedridden patients in the ICU (unless contraindicated) and the introduction of methylprednisolone upon admission would have contributed to the reduction in this mortality. In addition,

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the comorbidities encountered in our context were less severe (hypertension, diabetes and heart failure) compared to those reported in high-income countries such as cancers, autoimmune pathologies, history of organ transplants [17]. Regarding this mortality, it was noted that it was high in mechanically ventilated patients: 100% of cases in our series. In our environment, invasive mechanical ventilation remains very difficult and very limited by the lack of qualified personnel, the insufficiency of the material and medicinal resources necessary to ensure quality ventilation. High death rates under invasive ventilation have been reported by Ngomas et al in Gabon (97%) [12] and Benhocine et al in Algeria (81.51%) [13]. In developed countries where health facilities have state-of-the-art equipment, the proportions of deaths under invasive mechanical ventilation remained considerable [7,8,17]. The problem therefore remained: is mortality linked to the patient, to the disease and its complications, or to the oxygenation technique? In our context, we observed that the factors of poor prognosis of COVID-19 patients in the ICU were age greater than or equal to 70 years, hypertension, heart failure, critical lung damage (> 75%), and mechanical ventilation. In addition to the decompensation of comorbidities due to SARS-CoV2, would invasive mechanical ventilation also be an aggravating factor? The strategy in our situation was to opt as much as possible for non-invasive oxygen therapy (62.22%) in order to give the patients a chance of survival. In addition to comorbidities (hypertension, diabetes), Donamou et al, Ngomas et al, reported the correlation between death and invasive ventilation, thus, choosing non-invasive oxygenation techniques in 95% and 83.4% of cases respectively [10,12]. In any case, the respiratory support of severe COVID-19 patients remains difficult in developed settings and very challenging in environments with limited resources. Non-invasive oxygen therapy techniques appear to be effective means, with adequate and efficient management of septic status and rigorous control of comorbidities.

Conclusion

The respiratory support of severe COVID-19 patients is very difficult in resource-limited settings, especially with regard to invasive ventilation, the results of which are not promising. Non-invasive oxygen therapy would be an option to reduce mortality from severe COVID-19.

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Conflict of Interest

The authors declare that they have no conflict of interest in relation to this work.

References

1. Wang D, Hu B, Hu C, Zhu F, Liu X, et al. (2020) Clinical characteristics of 138 hospitalized patients with 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China. JAMA 323(11): 1061-1069.
2. Huang C, Wang Y, Li X, Ren L, Zhao J, et al. (2020) Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The lancet 395(10223): 497-506.
3. Qun L, Guan X, Wu P, Wang X, Zhou L, et al. (2020). Early transmission dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia. N Engl J Med 382(13): 1199-1207.
4. Bonny V, Maillard A, Mousseaux C, Plaçais L, Richier Q (2020) [COVID-19: Pathogenesis of a multi-faceted disease]. Rev Med Interne 41(6): 375-389. [Article in French].
5. Conseil scientifiques des urgences de santé publique (2020) Protocole de prise en charge des cas de COVID-19 validé le 09/04/2020. Ministère de la santé publique. Cameroun.
6. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, et al. (2020) Clinical characteristics of coronavirus disease 2019 in China. N. Engl J Med 382(18): 1708-1720.
7. Ruan Q, Yang K, Wang W, Jiang L, Song J (2020) Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. Intensive Care Med 46(5): 846-848.
8. Yang X, Yu Y, Xu J, Shu H, Xia J, et al. (2020) Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med 8(5): 475-481.
9. Collienne C, Castanares-Zapatero D, Apraxine M, Beauloye C, Capes A, et al. (2020) Prise en charge aux soins intensifs des patients pour insuffisance respiratoire liée au COVID-19. Louvain Med 139(06–05): 383-389.
10. Donamou J, Bangoura A, Camara LM, Camara D, Traoré DA, et al. (2021) Caractéristiques épidémiologiques et cliniques des patients COVID-19 admis en réanimation à l'hôpital Donka de Conakry, Guinée : étude descriptive des 140 premiers cas hospitalisés [Epidemiological and clinical characteristics of COVID-19 patients admitted to the intensive care unit of Donka hospital in Conakry, Guinea: Descriptive study of the first 140 hospitalised cases]. Anesthésie & Réanimation 7(2): 102–109. French.
11. Gado AM, Ayouba Tinni I, Daou M, Yacouba A, et al. (2022) Aspects épidémiologiques, cliniques et évolutifs de la COVID-19 des patients actifs admis à l'Hôpital National de Niamey, Niger. Médecine d'Afrique Noire 6909: 489-494.
12. Ngomas JF, Ifoudji Makao A, Nze Obiang P, Nyangui DEM, Manga F, et al. (2022) Aspects épidémiologiques et facteurs de mauvais pronostic des patients atteints de COVID-19 admis en réanimation au Centre Hospitalier Universitaire de Libreville au Cours des Trois Premières Vagues de la Pandémie. Health Sci. Dis 23(6): 1-7.
13. Benhocine Y (2021) COVID-19 au service de réanimation : expérience du CHU Tizi-Ouzou. Algerian Journal of Health Sciences 3(2): 38-42.
14. Gattinoni L, Chiumello D, Caironi P, Busana M, Romitti F, et al. (2020) COVID-19 pneumonia: different respiratory treatments for different phenotypes ? Intensive Care med 46(6): 1099-1102.
15. Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, et al. (2020) Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy Region, Italy. JAMA 323(16): 1574-1581.

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16. Bhatraju PK, Ghassemieh BJ, Nichols M, Kim R, Jerome KR, et al. (2020) COVID-19 critically ill patients in Seattle Region- Case series. N Engl J Med 382(21): 2012-2022.

17. Mitra AR, Fergusson NA, Lloyd-Smith E (2020) Baseline characteristics and outcomes of patients with COVID-19 admitted to intensive care units in Vancouver, Canada: a case series. CMAJ 192(26): 694-701.

DOI: 10.19080/JAICM.2023.12.555839

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